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Biogeographic implications of Ascidiacea (Tunicata) from the Wessel Islands (Arafura Sea)

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ABSTRACT

A collection of ascidians from the Wessel Islands (off north-eastern Arnhem Land) confirms the Indo-West Pacific affinities of the Australian tropical ascidian fauna. The collection, dominated by species of the family Didemnidae previously observed to be diverse in tropical waters, includes several of the species with obligate *Prochloron* symbioses. The collection also contains three large solitary species (*Polycarpa aurita, P. papillata* and *Microcosmus helleri*) known to have a pan-tropical range. The geographic range and life history strategies of the majority of species in this collection support the view that gene flow in the Indo-West Pacific and through the straits to the north of the Australian continent that connect the two oceans is not constrained by either a short free-swimming larval life, or internal fertilisation in the fixed, colonial organisms that dominate the tropical fauna. In colonial species at least, population maintenance may be a more significant selective advantage than gene flow through larval dispersal.

KEYWORDS: Indo-West Pacific, temperate, tropical, pan-tropical, Didemnidae, gene flow.

INTRODUCTION

The 35 ascidian specimens (colonies and solitary individuals) reported on below were taken by SCUBA from the Wessel Islands (in the Arafura Sea off north-eastern Arnhem Land; see Table 1). Colonial, especially didemnid species, dominate the species list, only five of the 25 species represented being solitary (Table 2).

The majority of the species in this collection have been recorded previously from northern Australia and are confirmed as common components of the benthic fauna occurring in tropical Australian waters. The collection contains species with a range in tropical and occasionally temperate waters of the western Pacific from Fiji to the eastern Australian coast (including the Great Barrier Reef), the northwestern Australian coast and sometimes further, occasionally to the West Indian Ocean. Only one species (*Tridemnum marmoratum*) known from the western Pacific is not yet recorded further west than the northern coast of Australia. At present the possibly indigenous Australian species known only from tropical seas are few (five being present in this collection, see Table 2). Four of the species present (including three that are solitary, *viz. Polycarpa aurita, P. papillata* and *Microcosmus helleri*) have a pan-tropical range.

The Aseidiacea are sessile (fixed) organisms with larvae free-swimming for relatively short periods and it is possible that they could be vulnerable to isolation and speciation. In fact, collections (including the present one, see Table 2 below) made in shallow tropical waters, where species diversity is high, are dominated by colonial species, which are invariably internally fertilised, brooding their embryos internally and with larvae free-swimming for particularly short periods. Further, these characteristics of colonial ascidians are particularly conspicuous in the Didemnidae, the most speciose family in the tropical ascidian fauna, in which larvae are free-swimming for periods of ten minutes or less. On the other hand, solitary species (with the exception of some species of *Polycarpa* and *Molgula*) are externally fertilised, embryos develop into tailed larvae in a planktonic phase, and be more likely agents of gene flow than the short-lived larvae of colonial species.

However, although the characteristics of the life histories of colonial ascidian species (in particular, the Didemnidae), tend to support an hypothesis of population isolation resulting in their speciation, the geographic range of the majority of shallow water tropical ascidian species (confirmed in the present collection) suggest that this hypothesis of isolation is incorrect; and that gene flow around the tropical Indian and West Pacific Oceans and through the straits that connect these oceans, separating the Australian continent from the islands to the north, is not impeded by the sessile habit of the adults, nor by internal fertilisation of eggs and brooding of embryos within the parental organism and a short free-swimming larval life.

Probably there are other selective advantages of a colonial habit not directly related to gene flow, *viz.* patterns and rates of growth to rapidly occupy substrata and exclude other benthic organisms and a tendency to population

Table 1. Collection data for specimens reported on below (NTM, Museum and Art Gallery of the Northern Territory registration number; NCI, National Cancer Institute voucher specimen). All locations are the Northern Territory (Australia).

NTM reg. no.	NCI No.	Latitude	Longitude	Site Description	Date collected	Depth of collection (m)	Depth range (m)	Habitat	Substrate
E500	0M9H2629-Y	11°47.89′S	136°29.04′E	Cotton Island, 100 m off Northern Bay, English Company Islands.	30 Mar 04	14	13-16	Coral heads	Fine sand
E501	0M9H2633-F	11°47.89′S	136°29.04′E	Cotton Island, 100 m off Northern Bay, English Company Islands.	30 Mar 04	14	13-16	Coral heads	Fine sand
E502	0M9H2657-G	11°38.60′S	136°17.83′E	Raragala Island, large bay on SW side of island, Wessel Islands.	30 Mar 04	18	17-20	Rocky	Coarse sand, rubble
E503	0M9H2668-R	11°33.91′S	136°22.34′E	Raragala and Guluwuru Islands (Gugari Rip), Wessel Islands.	30 Mar 04	23	19-27	Channel	Rock, sand
E504	0M9H2669-S	11°38.60′S	136°17.83′E	Raragala Island, large bay on SW side of island, Wessel Islands.	30 Mar 04	18	17-20	Rocky	Coarse sand, rubble
E505	0M9H2670-T	11°32.85′S	136°21.28′E	Raragala Island, 700 m NE of tip, Wessel Islands.	31 Mar 04	14	13-16	Muddy bottom	Mud, rock
E506	0M9H2674-X	11°32.85′S	136°21.28′E	Raragala Island, 700 m NE of tip, Wessel Islands.	31 Mar 04	14	13-16	Muddy bottom	Mud, rock
E507	0M9H2676-Z	11°06.69′S	136°41.26′E	Trafalgar Bay Headland, Marchinbar Island, Wessel Islands.	31 Mar 04	10	9-12	Rocky reef	Rock, sand
E508	0M9H2677-A	11°06.69′S	136°41.26′E	Trafalgar Bay Headland, Marchinbar Island, Wessel Islands.	31 Mar 04	10	9-12	Rocky reef	Rock, sand
E509	0M9H2678-C	11°06.69′S	136°41.26′E	Trafalgar Bay Headland, Marchinbar Island, Wessel Islands.	31 Mar 04	10	9-12	Rocky reef	Rock, sand
E510	0M9H2687-N	11°01.29′S	136°43.55′E	Marchinbar Island, 900 m NW of Emu Islet, Wessel Islands.	31 Mar 04	18	11-17	Rocky reef	Rock, sand
E511	0M9H2718-V	11°10.95′S	136°39.24′E	Shark Point, 1 km W of Jensen Bay, Marchinbar Island, Wessel Islands.	02 Apr 04	18	17-20	Rocky reef	Rock, silt, sand
E512	0M9H2727-H	11°24.69′S	136°28.85′E	Hopeful Bay, 340 m NW of Breakwater Point, Marchinbar Island, Wessel Islands.	02 Apr 04	18	10-19	Rocky reef	Mud, rock
E513	0M9H2740-U	11°28.30′S	136°25.43′E	Guluwuru Island, 580 m NE of tip, Wessel Islands.	03 Apr 04	18	14-15	Rocky	Rock, silt
E514	0M9H2741-V	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E515	0M9H2742-W	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E516	0M9H2743-X	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E517	0M9H2744-Y	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E518	0M9H2745-Z	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E519	0M9H2746-A	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E520	0M9H2747-C	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E521	0M9H2748-F	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E522	0M9H2749-G	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E523	0M9H2750-H	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E524	0M9H2751-I	11°41.17′S	136°02.03′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E525	0M9H2753-K	11°41.19′S	136°02.13′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral bommies, sand
E526	0M9H2754-L	11°41.19′S	136°02.13′E	Drysdale Island, 600 m offshore of SE side of island, Wessel Islands.	04 Apr 04	18	17-20	Coral heads	Coral Bommies, sand
E527	0M9H2768-Z	11°38.56′S	136°17.85′E	Raragala Island, 240 m NE of bay on SW side, Wessel Islands.	05 Apr 04	18	11-20	Rocky reef	Coral, sand, rubble
E528	0M9H2782-Q	11°38.27′S	136°17.52′E	Raragala Island, 600 m NE of bay on SW side, Wessel Islands.	05 Apr 04	14	13-14	Sandy bottom	Sand, mud
E529	0M9H2783-R	11°38.27′S	136°17.52′E	Raragala Island, 600 m NE of bay on SW side, Wessel Islands.	05 Apr 04	14	13-14	Sandy bottom	Sand, mud
E530	0M9H2802-N	11°23.26′S	136°29.36′E	Marchinbar Island, 3 km N of Breakwater Point, Wessel Islands.	02 Apr 04	18	15-17	Rocky	Mud, rock
E531	0M9H2803-O	11°06.69′′S	136°41.26′E	Trafalgar Bay Headland, Marchinbar Island, Wessel Islands.	31 Mar 04	10	9-12	Rocky reef	Rock, sand

Table 2. Species of ascidians taken from the Wessel Islands and English Company Islands, showing their previously known geographic range and NTM registration number(s) of relevant specimens. * IWP, Indo-West Pacific; NE, northeastern Australia; NW, northwestern Australia; WP, West Pacific.

Taxon name	Recent reference	Previously known geographic range*	NTM reg. no.	No. specs.
Suborder Aplousobranchia				
Family Polycitoridae				
Polycitor cirees Michaelsen, 1930	Kott 2004	WP, NE, NW and northern Australia	E518	1
Eudistoma eboreum Kott, 1990a	Kott 2008	NW, NE and northern Australia	E502	1
			E513	1
			E524	1
Eudistoma ovatum (Herdman, 1886)	Kott 2004	Northern Australia	E508	3
			E520	1
Eudistoma pyriforme (Herdman, 1886)	Kott 1990a	Torres Strait, NW, NE Australia	E522	1
Family Didemnidae				
Leptoclinides brandi Kott, 2001	Kott 2004	NE, northern Australia	E514	1
Leptoclinides cf. *rigidus* Kott, 2001	Kott 2005a	WP, NE, NW and northern Australia	E521	1
Polysyncraton oceanium Kott, 2001	Kott 2004	WP and northern Australia	E519	1
Didemnum clavum Kott, 2001a	Kott 2004	WP NW Australia	E515	1
Didemnum molle (Herdman, 1886)	Kott 2001	IWP tropical/temperate Australia	E527	1+
Didemnum psammatode (Sluiter, 1895)	Kott 2002	IWP tropical/temperate Australia	E510	1
			E517	1
Didemnum roberti Michaelsen, 1930	Kott 2004	NW, northern Australia	E501	!
Didemnum viride (Herdman, 1906)	Kott 2002	IWP, NW, NE Australia	E525	1
Trididemnum marmoratum (Sluiter, 1909)	Kott 2004	WP, northern Australia	E516	1
			E509	1
Trididemnum savignyi (Herdman, 1886)	Kott 2001	Pan-tropical, NW, NE Australia	E526	1
Trididemnum sibogae (Hartmeyer 1910)	Kott 2007	IWP tropical / temperate Australia	E529	1
Lissoclinum badium F. and C. Monnot, 1996	Kott 2004	WP, NW, NE Australia	E523	1
Lissoclinum multifidum (Sluiter, 1909)	Kott 2004	IWP, northern and southern Australia	E503	1
Suborder Phlebobranchia				
Family Ascidiidae				
Phallusia arabica Savigny, 1816	Kott 1985	IWP, NW, NE Australia	E530	1
Family Perophoridae				
Perophora modificata Kott, 1985	Kott 2004	WP, NE Australia, Ashmore Reef	E507	1
Suborder Stolidobranchia				
Family Styclidae (Subfamily Styclinae)				
Polycarpa aurita (Sluiter 1890)	Kott 2008	Pan-tropical, NW, NE Australia	E594	1
Polycarpa longiformis Tokioka, 1952	Kott 1985	NW, NE Australia, Japan	E500	1
Polycarpa papillata (Sluiter, 1885)	Kott 2006	Pan-tropical, tropical/temperate Australia	E505	1
			E512	1
Family Styelidae (Subfamily Polyzoinae)				
Stolonica australis Michaelsen, 1927	Kott 1985	Temperate Australia	E528	1
Symplegma brakenhielmi (Michaelsen, 1904)	Kott 2004	IWP and temperate Australia	E531	1
Family Pyuridae				
Microcosmus helleri Herdman, 1882	Kott 1985	Pan-tropical, tropical/temperate Australia	E511	1
			E506	1

maintenance by concentration of recruits (resulting from reduction in the larval exposure to dispersal, albeit retaining larvae that are free-swimming for minimum periods for site selection). The maintenance of stable populations may enhance opportunities for fertilisation (both internal and external) that transcend the advantages of increasing gene flow through a longer larval life; and form links in chains of recruitment around the margins of the continents and between the islands and reefs of the western Pacific and Indian Oceans.

Unfortunately, at this stage there is little data available on the patterns of life histories, population dynamics and selective advantages reflected in the dominant groups of the diverse ascidian fauna in the tropical Indo-West Pacific (see Kott 1985, 1990, 2001: glossary entries for fertilisation and gene flow).

BIOGEOGRAPHIC NOTES

Generally the species of ascidians represented in this collection are those that would be expected in the north of Australia. They can be divided into the following groups:

1. Species with a wide pan-tropical range. *Microcosmus helleri* and *Polycarpa papillata* are known to extend also around Australia into temperate waters, but *Tridemnum savignyi* and *Polycarpa aurita* do not extend further south than the tropics.
2. Species known from the tropical West Pacific (including north-eastern Australia) and the Indian Ocean. For some species in this group, the only Indian Ocean record is off north-western Australia (*Polycitor circes, Leptoclinides* cf. *rigidus, Didemnum clavum, Lissoclinum badium* and *Perophora modificata*), but others (*Didemnum molle, Didemnum viride, Phallusia arabica, Didemnum psammatode, Tridemnum sibogae* and *Symplegma brackenhielmi*) extend to the West Indian Ocean and the last two species listed also extend from the tropics into temperate waters around the southern coast of Australia. *Lissoclinum multifidum* is recorded from the western Pacific, the Indian Ocean and northern Australia as well as southern Australia, but has not been recorded from north-eastern or north-western Australia and it is possible that more than one species is involved.
3. Only one species is known only from the western Pacific including northern eastern Australia (*Tridemnum marmoratum*).
4. Species, possibly indigenous, known from the north of Australia, including the north-western and / or north-eastern coasts (*Endistoma eborenm, E. ovatum, E. pyriforme, Leptoclinides brandi, Polysyncraton oceanium, Didemnum roberti, Polycarpa longiformis*) have not been recorded outside Australian waters.
5. *Stolonica australis* is the only species not previously reported outside temperate Australian waters and the present new record from the Wessel Islands is an extension of its known geographic range.

TAXONOMIC NOTES

The specimens in this collection were photographed *in situ* by their respective collectors. Unfortunately, the photographed specimen (Figs 1–3) is not necessarily the same specimen as the one examined and reported on here.

Polycitor circes Michaelsen, 1930

(Fig.1A)

Polycitor circes Michaelsen, 1930: 495; Millar 1975: 205, part, specimens from Marongas (20.iii.14); Monniot 1988: 207; F. and C. Monniot 1996: 184; F. and C. Monniot 2001: 249; Kott 1990a: 169 and synonymy; Kott 2002: 26. Not Millar 1975: 205 part, specimen from Marongas (19.iii.14) and those from other locations (see Remarks, below).

Distribution. *Previously recorded* (see Kott 1990a): Western Australia (north-western Australia, Shark Bay, Cockburn Sound); Queensland (Martha Ridgeway Reef); Northern Territory (Darwin), Papua New Guinea, New Caledonia, Indonesia, Philippines. *New record:* Northern Territory (Northern Territory (Wessel Islands, NTM E518).

Description. The newly recorded colony is a firm gelatinous translucent vertical column, expanded slightly at the top where the test is slightly softer and more translucent than the firm test that forms the stalk. The surface of the colony is smooth and even.

The zooids extend from the upper surface of the head where each zooid opens to the exterior by two separate 6-lobed apertures. They extend parallel to one another toward the base of the stalk. Zooids are very long, with a long oesophageal neck. The abdomen continues past the pole of the gut loop and terminates in a vascular stolon. Longitudinal muscles extend along the length of the zooid and terminate in a short horn-like protrusion on each side of the anterior part of the posterior abdominal stolon (posterior to the pole of the gut loop). About 25 rows of stigmata are in the large thorax. The stomach, at the posterior end of the abdomen, has about 20 longitudinal folds. The gonads are in the gut loop and consist of a few large eggs and many small testis follicles scattered through and around the pole of the gut loop. Large embryos are present moving up the oviduct as it extends up the oesophageal neck toward the atrial cavity. Larval adhesive organs are triradially arranged at the anterior end of the trunk.

Remarks. The present colony resembles many assigned to *Diazona fungia* (see F. and C. Monniot 2001, Fig. 123E). However it is readily distinguished by the absence of internal longitudinal vessels in the branchial sac, the conspicuous folds in the stomach (rather than the internal striations of *Diazona*) and by the embryos moving up through the abdomen (fertilisation having taken place in the base of the oviduct).

Colonies from Deo Roa (Philippines) with small flat-topped lobes branching off basal stolons assigned to this species by Millar (1975) are probably specimens of *Clavelina arafurensis* Tokioka, 1952. They are quite different from the massive robust vertical lobes of the type specimens of the present species (Michaelsen 1930) and others described by Kott (1990a) from Western Australia. Another specimen Millar (1975) described from Deo Roa with smooth margins around the apertures appears to be a *Pycnoclavella* sp. Of the other specimens Millar (1975) assigned to this species, one from Marongas (20.iii.14, Millar 1975) appears to be properly assigned, although the other specimen from that location (19.iii.13) without stomach folds may be a specimen of *Polycitor translucidus*.

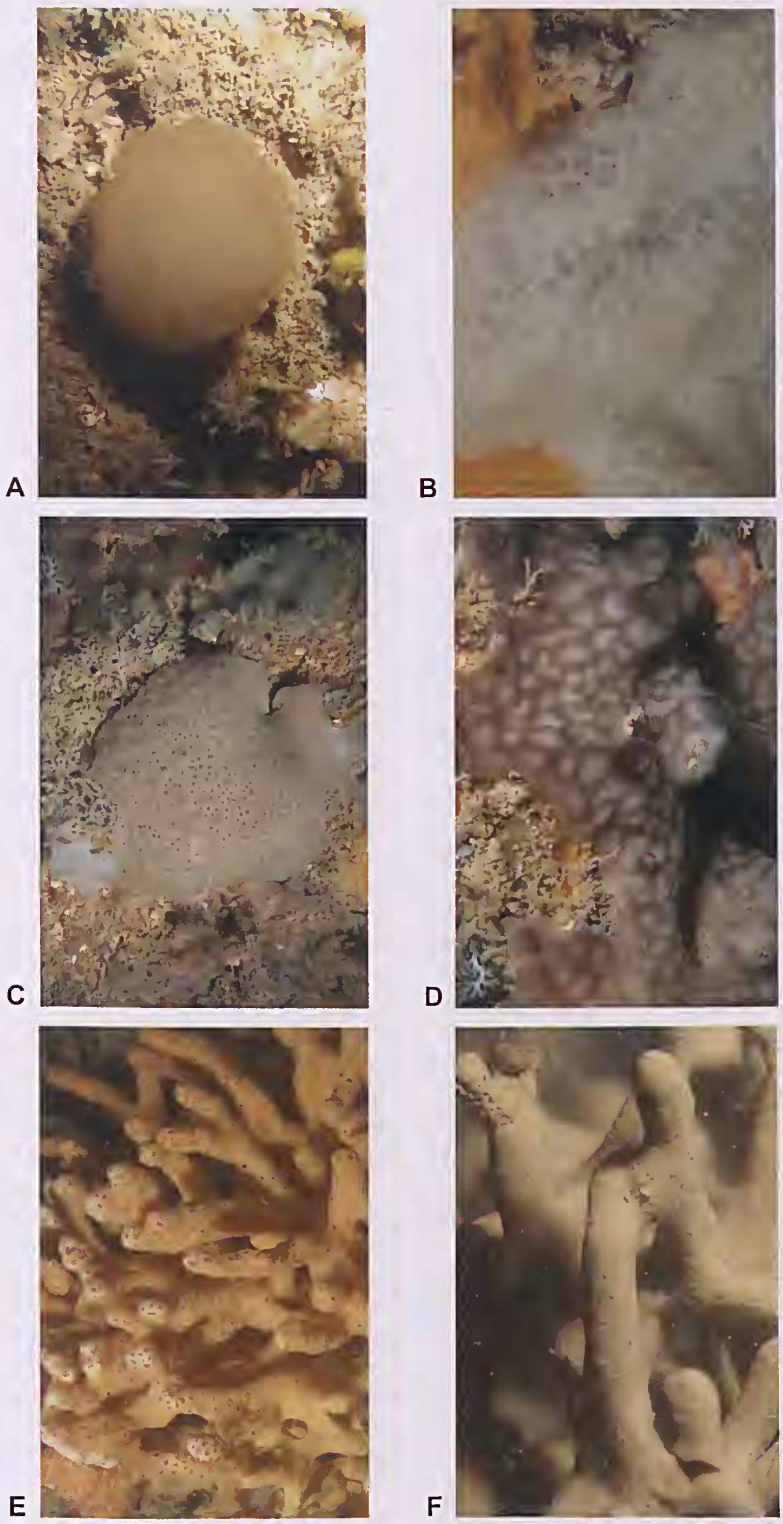

Fig 1. **A**, *Polycitor circes*; **B**, *Eudistoma eboreum*; **C**, *Eudistoma ovatum*; **D**, *Leptoclinides* cf. *rigidus*; **E**, *Didemnum clavum*; **F**, *Didemnum psammatode*. Photos: **A**, P. Colin; **B**, **D–F**, D. de Maria; **C**, M. Browne.

The specimens assigned to *Polycitor giganteus* by F. and C. Monniot (2001) and Kott (2005b) from New Caledonia and the Solomon Islands, respectively, lacking stomach folds and having larval adhesive organs in a median vertical line, probably are also specimens of *Polycitor translucidus*. *Polycitor giganteus* Herdman, 1899 has zooids of similar proportions to the present species but is known mainly from temperate Australian waters and has only four stomach folds (see Kott 1990a).

Although not described, specimens from Papua New Guinea appear to have been accurately assigned to *Polycitor circes* by F. and C. Monniot (2001). Specimens from New Caledonia and Indonesia (F. Monniot 1988; F. and C. Monniot 1996) also appear to be members of the present species.

Eudistoma eboreum Kott, 1990

(Fig. 1B)

Eudistoma eboreum Kott, 1990a: 205; Kott 2002: 27; Kott 2008: 1118.

Distribution. *Previously recorded* (see Kott 2008): Western Australia (Kalbarri); Northern Territory (Darwin); Queensland (Lizard Island). *New records*: Northern Territory (Wessel Islands, NTM E502, E513, E524).

Description. The newly recorded colonies are purple-brown, translucent, firm gelatinous slabs with evenly distributed groups of about four to six zooids arranged in a circle with their atrial apertures opening to the surface in the centre of the circle and their branchial openings around the circumference. In the living colonies there is some variation in the extent to which these systems are depressed into the surface, although in preserved specimens the surface is more or less even. Also photographs of two of the newly recorded specimens show the colonies to have been a whitish colour and pale, but the other colony (NTM E513) is distinctly grey-blue. Collector's notes describe one of these colonies (NTM E524) to have been brown-black internally. However, in preservative all three specimens are grey with diffuse brown pigment in the test of the upper half of the colony. Zooids have the characteristic layer of transverse muscles in the thoracic body wall that overlies strong longitudinal bands extending the length of the long zooids. Atrial apertures are on a long siphon. Three rows of stigmata are in the branchial sac, which is separated from the smooth-walled stomach at the posterior end of the zooid by a long oesophageal neck. A small vascular stolon is at the posterior end of the body.

Remarks. Although the colour of living specimens of this species is variable, their colour in preservative is more or less the same. The robust zooids in circular rudimentary systems in the firm grey translucent slabs of test are characteristic of this species. It is known from relatively few specimens across the northern tropical coast of Australia.

Eudistoma ovatum Herdman, 1886

(Fig. 1C)

Eudistoma ovatum Herdman, 1886: 246; Kott 2004: 42 and synonymy. Not Kott 1990a: 222 and synonymy (see *E. pyriforme* below).

Distribution. *Previously recorded* (see Kott 2004): Northern Territory (Torres Strait, Gulf of Carpentaria, Bynoe Harbour). *New records*: Northern Territory (Wessel Islands, NTM E508: 3 specimens, E520: 1 specimen).

Description. Colonies are vertical to conical or rounded lobes to 2 cm diameter and 3 cm high, sessile or with a thick short stumpy basal stalk. Muddy-looking plant cells, faeces pellets and sand are embedded in the soft test around the long robust zooids that extend from the upper surface toward the base of the colony. The zooids are arranged in circles with the long atrial siphons opening in the centre of the circle and the branchial openings in an outer circle. Zooids are muscular with an outer layer of transverse muscles and inner longitudinal bands along the length of the zooids, which extend from the upper surface toward the base of the colony. As is usual in this genus, the oesophageal neck is very long. In this species, the gut forms a spiral in the posterior end of the loop.

Remarks. The spiral in the gut loop and the inclusions of various particles in the test are characteristic of this species. The former character distinguishes the species from the otherwise similar *Eudistoma amplum* (Sluiter, 1909). *Polycitor multiperforatus* Sluiter, 1909 also is a similar species, although it appears to have more stigmata per row (30) and the circular arrangement of zooids was not detected in the syntypes (see Kott 1990a).

Eudistoma pyriforme (Herdman, 1886)

Psammaplidium pyriforme Herdman, 1886: 419.

Eudistoma pyriforme. — Kott 1990a: 226 and synonymy.

Eudistoma ovatum. — Kott 1990a: 222.

Distribution. *Previously recorded* (see Kott 1990a): Western Australia (Onslow); Queensland (Bundaberg); Torres Strait. *New record*: Northern Territory (Wessel Islands, NTM E522).

Description. The colony is a flat slab with the margins raised around the flattened upper surface. Fine sand is on the upper surface, interrupted where the zooids open separately to the exterior. Sand also is present throughout the colony. Some excrescences or root-like projections are around the sides of the colony enmeshed with sand and other particles. Zooids are contracted and the abdomen is contracted to about the same length as the thorax. Three rows of stigmata were detected in the branchial sac but other details of the zooids were not observed. Two small larvae are in the thorax of the newly recorded specimen.

Remarks. The present colony is not unlike those previously reported for this species. Although some sand and possibly symbionts are embedded in the test, it lacks the upright lobes, the conspicuous circular systems and

the spiral at the distal end of the gut loop of *E. ovatum*, a species that often has been confused with it.

Leptoclinides brandi Kott, 2001

Leptoclinides brandi Kott, 2001a: 40. — Kott 2004: 2468.

Distribution. *Previously recorded* (see Kott 2004): Queensland (Great Barrier Reef); Northern Territory (Darwin and Bynoe Harbour). *New record*: Northern Territory (Wessel Islands, NTM E514).

Description. The tough, fleshy-looking colony has a smooth surface raised into mounds and ridges. A layer of large, stellate spicules (to 0.08 mm diameter) with 9–13 moderately long and pointed conical rays in optical transverse section are in the surface of the colony but the remainder of the translucent test has only sparse spicules. In life, the colony is greyish white. The arrangement of the common cloacal systems is obscured by compression of the colony. Zooids are very contracted, although the branchial siphon is long with a bulbous expansion halfway along it. The atrial siphon is long and oriented posteriorly. Stigmata are relatively short in these contracted zooids but they appear to be pointed at each end. About six male follicles are in a circle and the vas deferens coils five times.

Remarks. The newly recorded colony resembles those previously described, although its condition obscures some of its characters, especially the fusiform stigmata. The stigmata and their distribution are characteristic of the species and these together with the testis follicles and coils of the vas deferens distinguish the species from those in the *dubius* group, which resemble the present colony in some respects.

Leptoclinides cf. *rigidus* Kott, 2001

(Fig.1D)

Leptoclinides rigidus Kott, 2001a: 77; Kott 2005a: 2425 and synonymy.

Distribution. *Previously recorded* (see Kott 2005a): Western Australia (Ashmore Reef, Montebello Islands); Queensland (Great Barrier Reef); Northern Territory (Darwin, Wessel Islands); Papua New Guinea. *New record*: Northern Territory (Wessel Islands, NTM E521).

Description. Colonies are gelatinous sheets overgrowing the substrate. The small zooids are arranged along each side of canals that surround zooid-free circular areas about 3 mm diameter, each containing a patch of spicules beneath a superficial bladder cell layer. Spicules are sparse in the remainder of the test. Large sessile common cloacal apertures are at the junctions of some of the common cloacal canals, which all contain some faecal pellets. The spicules are to 0.05 mm diameter with 7–9 conical rays in optical transverse section. Some of the ray tips are relatively blunt. In life, the colonies are a reddish brown. Little of the zooid structure can be determined. As in all species of this genus a posteriorly orientated atrial siphon is present and a retractor muscle was not detected

Remarks. Superficially the specimen resembles the temperate *Leptoclinides rigidus*, which has been recorded previously from this location. However specimens previously assigned to the species are reported to have been blue in life. The present specimen resembles *Didemnum viride* in life, but it could be an undescribed species of the genus *Leptoclinides*. *Leptoclinides volvus* Kott, 1975 has similar common cloacal systems, but it is a stalked colony and is also a temperate species.

Polysyncraton oceanium Kott, 2001

Polysyncraton oceanium Kott, 2001a: 115.

Distribution. *Previously recorded* (see Kott 2001a): Queensland (Great Barrier Reef); Fiji. *New record*: Northern Territory (Wessel Islands, NTM E519).

Description. The colony is an investing sheet with firm translucent test. A thin layer of evenly spaced but not crowded spicules is in the surface test beneath a superficial layer of bladder cells. A sparse layer of spicules also is on the base of the colony but there are no spicules in the test between the surface and basal layers. Spicules are stellate, to 0.035 mm diameter, with 11–15 short pointed rays that break up readily. A common cloacal cavity was not detected in this specimen, although the zooids sometimes were seen to be arranged in double rows, presumably along each side of canals. Five coils of the vas deferens were detected, but the gonads were not seen, although some large eggs are present in the basal test.

Remarks. The form and distribution of the spicules resemble those of *Didemnum caesium* Sluiter, 1909, *Polysyncraton rica* Kott, 2001, *P. otuetue* C. & F. Monniot, 1987 and *P. scobinum* Kott, 2001, but they are smaller. The specimen generally conforms to those previously assigned to *Polysyncraton oceanium*.

Didemnum clavum Kott, 2001

(Fig. 1E)

Didemnum clavum Kott, 2001a: 163; Kott 2004: 53.

Distribution. *Previously recorded* (see Kott 2004): Western Australia (NW Australia to Port Hedland); Northern Territory (Darwin); Indonesia. *New record*: Northern Territory (Wessel Islands, NTM E515).

Description. The colony is the characteristic branched structure with red pigment particles in the surface and spicules crowded throughout. The spicules are small, stellate, with occasional giant spicules, with 4–6 long pointed rays, scattered amongst them

Remarks. Although other tropical *Didemnum* species are a similar red-pink colour, the present species is readily identified by the form of the colonies and the occasional giant spicules with relatively few rays scattered amongst the smaller stellate spicules.

***Didemnum molle* (Herdman, 1886)**

Diplosomoides molle Herdman, 1886: 310.

Didemnum molle. — Kott 2001: 208 and synonymy.

Distribution. *Previously recorded* (see Kott 2001): NW, NE and northern Australia to Cockburn Sound and one record from Esperance. Western Pacific, the Indian Ocean (to Mauritius, Madagascar), Vietnam. *New record*: Northern Territory (Wessel Islands, NTM E527).

The newly recorded location is well within the vast geographic range of this shallow reefal species, one of the most frequently recorded of the didemnid-*Prochloron* symbioses.

Description. The species is readily identified, forming vase-shaped colonies with a central test core separated from the outer zooid-bearing layer of the colony by a vast common cloacal cavity lined by green symbiotic cells, which can be seen through the large terminal common cloacal aperture. The species characteristically secretes vast quantities of mucus in which the green symbiotic cells are liberated from the colony when it is disturbed.

Remarks. The species is discussed in Kott (2001).

***Didemnum psammatode* (Sluiter, 1895)**

(Fig. 1F)

Leptoclinum psamathodes Sluiter, 1895: 171.

Didemnum psammatode. — Kott 2002: 38.

Distribution. *Previously reported* (see Kott 2002): a wide recorded range in the Indian and Pacific tropical/temperate oceans between Sri Lanka, the Red Sea to Fiji and extending to southern Australia and the South China Sea. *New records*: Northern Territory (Wessel Islands, NTM E510, E517)

Description. The newly recorded specimens are as previously described, with mud-coloured faecal pellets crowded in the test and minute spicules around each zooid opening.

***Didemnum roberti* Michaelsen, 1930**

(Fig. 2A)

Didemnum roberti Michaelsen 1930: 516; Kott 2004: 58 and synonymy.

Distribution. *Previously recorded* (see Kott 2004): Western Australia (north west to Cockburn Sound); Northern Territory (Gulf of Carpentaria, Darwin, Torres Strait). *New record*: Northern Territory (English Company Islands, NTM E501).

The species is commonly recorded from the northwestern coast of the continent and from Darwin, the Gulf of Carpentaria and Torres Strait, but it is not yet reported from northeastern Australia or from locations in the Western Pacific. At this stage, its records suggest that it is one of the few indigenous Australian tropical species.

Description. The colony is robust with terminal large circular common cloacal apertures on the rounded surface swellings, branches and ridges. The surface is always smooth and even. Spicules are in a relatively sparse layer at the surface and are more sparsely distributed and often patchy internally. They also are in a sparse but even layer lining the extensive common cloacal cavity that separates the central test core from the surface zooid-bearing layer of the colony. Zooids are in clumps, each attached by a short basal connective that traverses the common cloacal cavity from the centre of the under surface of each clump. Each zooid has a fine retractor muscle. The atrial aperture is large, open and sessile and the vas deferens coils eight times around the undivided testis follicle. Larvae, with four pairs of lateral ampullae along each side of the antero-median adhesive organs, are embedded in the basal or central test.

Remarks. This species has robust but variable colonies with a similarly variable colour pattern. It resembles many species of *Leptoclinides* in its smooth outer surface and well-developed common cloacal systems with a large terminal common cloacal aperture and an extensive posterior abdominal cavity separating a central test core from an outer zooid-bearing layer. Assignation of the species to the genus *Didemnum* is confirmed by characteristics of zooids, such as the large open sessile atrial apertures; the fine tapering retractor muscle; and the undivided testis surrounded by the coiled vas deferens.

***Didemnum viride* (Herdman, 1906)**

(Fig. 2B)

Leptoclinum viride Herdman, 1906: 340.

Didemnum viride. — Kott 2001a: 9.

Distribution. *Previously reported* (see Kott 2001a): Western Australia (Montebello Islands); Queensland (Great Barrier Reef); Papua New Guinea, New Caledonia, French Polynesia, Indian Ocean (Sri Lanka). *New record*: Northern Territory (Wessel Islands, NTM E525).

Description. In preservative, the newly reported colony is a thin cream-coloured sheet with the surface marked by a mosaic of small elevated areas separated by narrow depressions over the common cloacal canals that are lined on each side by zooids. In life, the colony is brownish red in the depressed areas over the common cloacal canals. Spicules, to 0.05 mm diameter, are crowded in the basal half of the colony but are less crowded in the zooid layer. They have 7–11 conical rays with more or less rounded tips in optical transverse section.

Remarks. The specimen generally resembles *Didemnum poecilomorpha* F. & C. Monniot, 1996 although it lacks the two different types of spicules of the latter species. In the present collection the colony resembles that of *Leptoclinides* cf. *rigidus* (see above), but the oval elevations that form the mosaic on the surface of the colony are smaller in the present species.

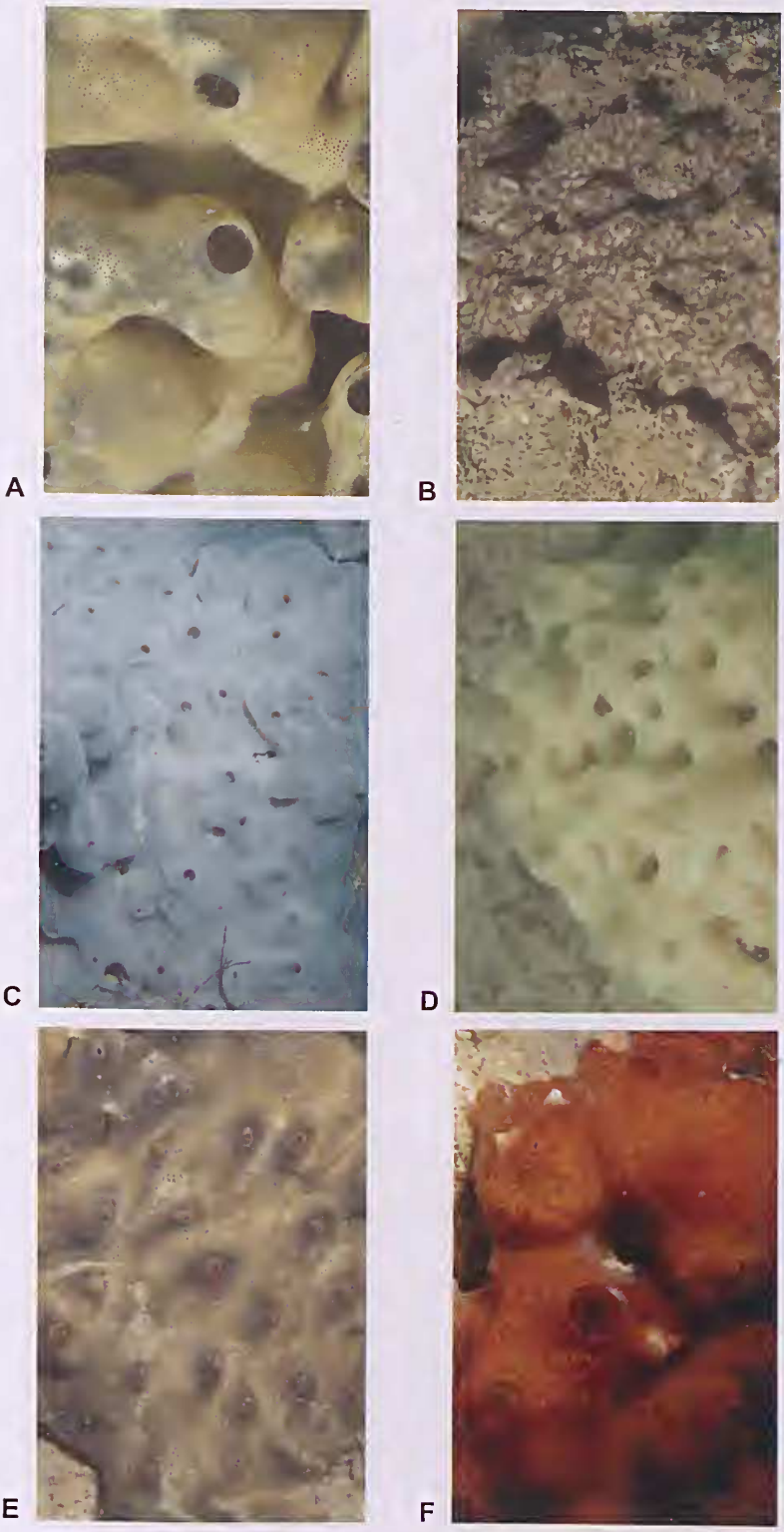

Fig 2. **A**, *Didemnum roberti*; **B**, *Didemnum viride*; **C**, *Tridemnum marmoratum*; **D**, *Tridemnum sibogae*; **E**, *Lissoclinum badium*; **F**, *Lissoclinum multifidum*. Photos: **A,B,D,E**, D. de Maria; **C,F**, P. Colin.

***Trididemnum marmoratum* (Sluiter, 1909)**

(Fig. 2C)

Leptoclinum marmoratum Sluiter, 1909: 84.

Trididemnum marmoratum. — Kott 2002: 38; Kott 2004: 61.

Distribution. *Previously reported* (see Kott 2004): Northern Territory (Gulf of Carpentaria, Darwin); Indonesia. *New records*: Northern Territory (Wessel Islands, NTM E509, E516).

Description. One of the newly reported colonies (E516) has relatively uniform rounded elevations about 1.0 cm diameter at the base and up to 0.5 cm high, each with a terminal common cloacal aperture. The other specimen is an extensive encrusting sheet. Stellate spicules, to 0.09 mm diameter, with 9–13 conspicuously pointed or chisel-shaped rays in optical transverse section are in a thin layer beneath the superficial bladder cell layer but are absent from the remainder of the colony. Primary posterior abdominal common cloacal spaces beneath the surface layer of zooid-bearing test are traversed by clumps of zooids and surround a central test core in each of the conical elevations. Zooids are robust, with a posteriorly orientated atrial siphon opening into the posterior abdominal common cloacal cavity. Sometimes they have black squamous epithelium on the thorax and abdomen, although this was not always detected. Occasionally there is also a black endostylar pigment cap. A short retractor muscle is present from the posterior end of the thorax. A large spherical male follicle is surrounded by at least eight coils of the vas deferens. Larvae with a narrow waist behind a corona of eight club-shaped ectodermal ampullae with bifid tips on each side of the three antero-median adhesive organs are in the central test core.

Remarks. The specimens resemble closely those previously assigned to this species by Kott (2002).

***Trididemnum savignyi* (Herdman, 1886)**

Didemnum savignyi Herdman, 1886: 281.

Trididemnum savignyi. — Kott 2001a: 64.

Distribution. *Previously reported* (see Kott 2001a): Western Australia (Nares Rock); Queensland (Great Barrier Reef); Northern Territory (Darwin); tropical Atlantic. *New record*: Northern Territory (Wessel Islands, NTM E526).

Description. The newly recorded colony is an extensive thin sheet growing over a spiral worm tube, although the *in situ* photograph of this specimen is difficult to reconcile with its appearance in preservative. A sparse layer of large spicules, to 0.09 mm diameter, with 9–11 conical pointed rays in optical transverse section is beneath a superficial bladder cell layer. Spicules also line the oesophageal common cloacal canals but are absent from the remainder of the colony. Faecal pellets are embedded in the basal layer of test. Zooids have large funnel-shaped atrial siphons from about halfway down the dorsal surface of the thorax. Sometimes abdomina have dark squamous epithelium.

Remarks. The newly recorded specimen resembles previously reported specimens of this species, although the dark pigment previously thought to be characteristic is not present. This is presumably associated with intraspecific variability in this widely distributed species.

***Trididemnum sibogae* (Hartmeyer, 1910)**

(Fig. 2D)

Didemnum sibogae Hartmeyer, 1910: 261.

Trididemnum sibogae. — Kott 2001a: 283 and synonymy; Kott 2007: 1203 and synonymy.

Distribution. *Previously recorded* (see Kott 2007): Western Australia (Cape Jaubert); South Australia (Cape Jaffa); Victoria (Western Port); Tasmania (Port Davey); New South Wales (Port Hacking, Port Jackson, Arrawarra); Queensland (Great Barrier Reef and mainland locations between Fraser Island and Princess Charlotte Bay); Northern Territory (Darwin, Gulf of Carpentaria). Indonesia, New Caledonia, Indian Ocean (Gulf of Manaar). *New record*: Northern Territory (Wessel Islands, NTM E529).

The records indicate this species to be common in temperate as well as tropical waters around Australia.

Description. The newly recorded colony is a fist-sized three-dimensional reticulum (see Kott 2001a, Fig. 132A) with thin branches overgrowing and fusing with one another to form the sponge-like consistency of the colony. An *in situ* photograph shows the colony to be creamish-yellow. The colony has a superficial bladder cell layer and spicules are scattered relatively sparsely through the colony. An extensive posterior abdominal common cloacal cavity separates the zooid-bearing surface layer of test to the central test in each of the branches. Spicules are relatively small, to 0.06 mm diameter, stellate, with 7–11 conical, sharply pointed rays in optical transverse section. Zooids are small, with a short posteriorly oriented atrial siphon.

Remarks. The large, 0.016 mm diameter, spicules reported to occur occasionally in this species were not detected in the present specimen, although otherwise its characters conform to those previously reported.

***Lissoclinum badium* F. and C. Monniot, 1996**

(Fig. 2E)

Lissoclinum badium F. and C. Monniot, 1996: 170; Kott 2004: 69.

Distribution. *Previously recorded* (see Kott 2004): Western Australia (Bonaparte Archipelago); Queensland (Great Barrier Reef); Northern Territory (Darwin); Coral Sea, Timor Sea, Palau Is. *New record*: Northern Territory (Wessel Islands, NTM E523).

Description. The characteristic soft flexible specimen, dark brown internally, has large common cloacal apertures on surface ridges that are prominent on the living inflated colony. Specimens of this species are readily identified. Brown pigment cells are mixed with the especially small spicules in the surface of the colony and brown coloured zooids can be seen crossing the extensive thoracic common

cloacal cavity. The basal half of the colony is opaque with crowded spicules but the abdomina of the zooids are embedded in the floor of the common cloacal cavity where the spicules are less crowded.

Lissoclinum multifidum (Sluiter, 1909)

(Fig. 2F)

Leptoclinum multifidum Sluiter, 1909: 311.

Lissoclinum multifidum. — Kott 2004: 65 and synonymy.

Distribution. *Previously recorded* (see Kott 2004): South Australia (Flinders Island, etc); Tasmania (Forestier Peninsula); Northern Territory (Darwin); Indonesia, Gulf of Thailand, Mauritius. *New record*: Northern Territory (Wessel Islands, NTM E503).

Description. The colony is said to have been brown in life although in the *in situ* photograph it looks red. It encrusts rubble, some of which is mixed with the basal or central test mass. This is surrounded by an extensive common cloacal cavity crossed by test commissures that attach it to the zooid-bearing layer of test. Large common cloacal apertures are on surface elevations. Small sparse spicules, to 0.025 mm diameter, with a range of spicule rays from conical to rounded or rod-like are scattered through the test together with morula cells and possibly some plant cells as described previously for this species.

Remarks. Although Kott (2001a) had thought this species to be aspicular, it does in fact have minute spicules scattered through the test.

Phallusia arabica Savigny, 1816

(Fig. 3A)

Phallusia arabica Savigny, 1816: 164; Kott 1985: 61; Kott 2001b: 61 and synonymy.

Distribution. *Previously recorded* (see Kott 1985): Queensland (from the Capricorn Group, southern Great Barrier Reef, to Trinity Bay), Arafura Sea, Philippines, Sri Lanka, Red Sea, Gulf of Suez. *New record*: Northern Territory (Wessel Islands, NTM E530).

Description. The newly reported specimen has a robust, slightly curved body attached to the substrate about halfway down the convex ventral surface with a short conical atrial protuberance from the concavity about halfway down the dorsum. Anteriorly the body narrows to the terminal branchial aperture. The test is smooth, translucent and relatively firm and thick, and both atrial and branchial siphons appear to be firm and inflexible. However, internally the siphons are long and muscular, and the body lies loosely in the test and does not adhere to it. A mesh of longitudinal and transverse muscles is over the right side of the body and on the left a similar mesh is present but only anterior to the gut loop. Branchial tentacles are short and darkly pigmented in the preserved specimen. The long dorsal ganglion is at the base of the atrial siphon. A small U-shaped slit is on the dorsal tubercle at the anterior end of the dorsal lamina but a peritubercular -V is shallow. Very small secondary openings of the neural duct open into the peribranchial cavity along the left side of the dorsal lamina, which has conspicuous ribs along the left side of the membrane. The gut, on the left side of the posterior half of the body, is filled with mud. The rim of the anal opening is divided into about 20 short rounded scallops.

Remarks. This robust, widely ranging species is readily distinguished from *Phallusia obesa* (Herdman, 1880), *P. julinea* Sluiter, 1919 and *P. millari* Kott, 1985, all commonly occurring species of this genus in the Indo-West Pacific, by the smooth surface of the present species, the lack of chromatophores in the test, the presence of the dorsal ganglion at the base of the atrial aperture rather than halfway between the atrial opening and the dorsal tubercle and the lack of the sandy holdfast characteristic of *P. millari*.

Perophora modificata Kott, 1985

(Fig. 3B)

Perophora modificata Kott, 1985: 104; Kott 2004: 40 and synonymy.

Distribution. *Previously reported* (see Kott 2004): Western Australia (Ashmore Reef); Queensland (Great Barrier Reef), Coral Sea Plateau; Palau Islands, Philippines. *New record*: Northern Territory (Wessel Islands, NTM E507).

Description. The newly recorded specimen is a small clump of rounded yellow zooids each on a long stalk attached to a basal mat of stolons. The branchial sac has four rows of stigmata. The zooids in this and all other respects conforms to previous accounts of this readily identified species.

Polycarpa aurita (Sluiter, 1890)

(Fig. 3C)

Styela aurita Sluiter, 1890: 338.

Polycarpa aurita. — Kott 1985: 152 and synonymy; Kott 2008: 1199.

Distribution. *Previously reported* (see Kott 1985): Western Australia (Cape Jaubert, Shark Bay to Cockburn Sound); New South Wales (Port Jackson); Queensland (Moreton Bay to Lizard Island); Northern Territory (Gulf of Carpentaria); Indonesia, New Caledonia, Philippines; Atlantic Ocean (Venezuela, Gulf of Mexico, Caribbean). *New record*: Northern Territory (Wessel Islands, NTM E504).

The species has not yet been reported from the eastern Pacific, the Indian or the eastern Atlantic Oceans, but otherwise it is pan-tropical.

Description. The newly recorded specimen is robust with a hard leathery test. It is large and appears to be senescent, the gonads being degenerate, only traces being detected embedded deeply in the body wall. The species is identified principally by its large gut, large elliptical stomach, the strong ligament joining the two limbs of the primary loop, the long crowded vertical endocarps between the limbs of the gut loop and, on the body wall, the small

rounded scallops lining the rim of the anus and the deep conspicuous slit on the dorsal tubercle.

Remarks. The specimen is cryptic, the leathery wrinkled test being covered with epibionts and in the field it can be confused with other stolidobranch species in this collection, such as *Microcosmus helleri,* although it does not appear to form aggregates as many of these species do.

Polycarpa longiforuis Tokioka, 1952

(Fig. 3D)

Polycarpa longiformis Tokioka, 1952: 119; Kott 1985: 170 and synonymy.

Distribution. *Previously reported* (see Kott 1985): Western Australia (Port Hedland); Queensland (Martha Ridgeway Reef, Lizard Island, Cape Weymouth, Raine Island, Murray Island); Arafura Sea, Japan. *New record*: Northern Territory (English Company Islands, NTM E500).

Description. The newly reported specimen is large (about 4 cm long), almost cylindrical, grey and rubbery-looking with a smooth surface. The test, though thin, is firm and the muscular body wall adheres closely to it. The apertures are both anterior on conical protuberances diverging from one another. The lobes of the aperture are completely obscured by the firm gelatinous test. Posteriorly the body narrows to a holdfast attached to rocks and other rubble. The branchial folds are narrow and widely separated with 5–7 internal longitudinal vessels in the interspace and the meshes are long. The gut forms a short loop in the posterior end of the body and the rectum continues anteriorly to the base of the atrial siphon. The anal border has long, rounded lobes. Loosely attached long polycarps in an uneven row down each side of the body are obscured by the long vertical teardrop-shaped endocarps crowded on the body wall.

Remarks. In the field, the gelatinous smooth conical protuberances with their terminal apertures projecting from crevices can be mistaken for the very similar structures in *Phallusia* species (*P. julinea, P. arabica* and *P. obesa*) and in specimens of *Polycarpa papillata*. The close relationship with *P. papillata* is discussed by Kott (1985).

Polycarpa papillata Sluiter, 1885

(Fig. 3E)

Styela (Polycarpa) papillata Sluiter, 1885: 192.

Polycarpa papillata. — Kott 1985: 184 and synonymy; Kott 2006: 218.

Distribution. *Previously reported* (see Kott 1985): Western Ausralia (Dampier Archipelago to Cockburn Sound); South Australia (St Vincent Gulf); Victoria (Portland); New South Wales (Port Jackson); Queensland (Moreton Bay to Bathurst Island); Northern Territory (Gulf of Carpentaria, Darwin); Arafura Sea, Indonesia, Palau Islands, Philippines, Marianas Islands, Sri Lanka, Madagascar. *New records*: Northern Territory (Wessel Islands, NTM E505, E512).

Description. Long, tough specimens, pink in preservative with faint pink longitudinal stripes. The outer test is smooth and even without ridges or creases. The thin but muscular body wall is closely adherent to the test. The body narrows to the anterior terminal branchial opening which is turned to the right and slightly downwards. The atrial aperture is on a conical protrusion projecting out at an angle to the body about one-third of the distance down the dorsal surface. Branchial folds are long and narrow and widely separated from one another. The body wall has crowded upright leaf-like endocarps, flattened and sometimes indented around their rounded margins and constricted at their bases where they join the body wall. They are especially crowded around the gut loop in the posterior part of the body. The anus has 16 long and slightly frilly anal lobes around the margin. Long polycarps in about three irregular rows are embedded in the body wall or attached to it by a long ligament at their proximal ends, but the dorsal end of each polycarp with its terminal gonoducts is free of the body wall and directed toward the atrial opening.

Remarks. The species is common in the tropical Indo-West Pacific and although it resembles *P. longiformis,* it is readily identified by its red colour and longitudinal red stripes. It often has ejected its gut when collected although in the newly recorded specimens the body organs are all present.

Stolonica australis Michaelsen, 1927

Stolonica australis Michaelsen, 1927: 202; Kott 2003: 1642 and synonymy.

Distribution. *Previously recorded* (see Kott 2003): Western Australia (Albany); South Australia (Great Australian Bight, St Vincent Gulf, Investigator Strait, Kangaroo Island, Yorke Peninsula); Tasmania (Bruny Island, d'Entrecasteaux Channel); Victoria (Bass Strait, Anglesea, Portland, Western Port); New South Wales (Port Jackson). *New record*: Northern Territory (Wessel Islands, NTM E528).

Description. Zooids are vertical with a terminal branchial aperture and the atrial aperture antero-dorsal, each on a slight conical protuberance. Zooids are joined to one another and to basal stolons by short lateral commissures to form tight aggregations that are brownish pink in life. The test is thin but rigid. Two branchial folds and a possible third ventral rudimentary fold are on each side of the body. A typical branchial formula is 9DL4(12) 5(9) 9E. A total of about 40 internal longitudinal vessels are on each side. The stigmata are in about 20 rows. The dorsal tubercle is a longitudinal slit. About 25 longitudinal folds are in the stomach wall, of which six terminate on each side of the suture line. Only a short caecum projects from the pyloric end of the suture line into the gut loop. Small endocarps are scattered on the body wall and in the gut loop. Small male follicles are scattered in an arc around the postero-ventral curve of the right side of the body.

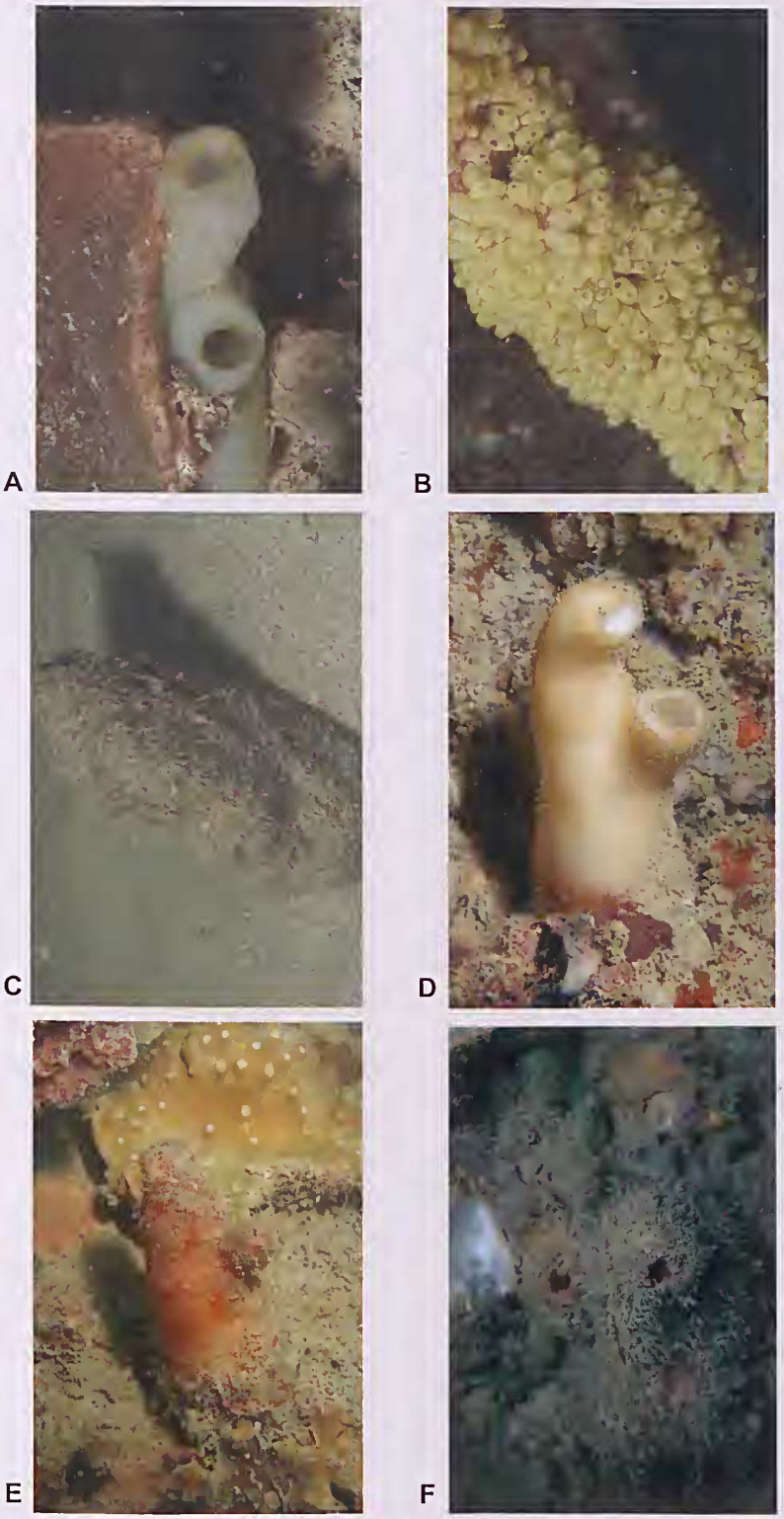

Fig 3. **A**, *Phallusia arabica*; **B**, *Perophora modificata*; **C**, *Polycarpa aurita*; **D**, *Polycarpa longiformis*: **E**, *Polycarpa papillata*; **F**, *Microcosmus helleri*. Photos: **A–C**, D. de Maria, **D,E**, P. Colin; **F**, B. Alvarez de Glasby.

Remarks. The present species has formerly been regarded as having a range limited to temperate waters, but the newly recorded material suggests that the range may be more extensive and include tropical waters. It does have some similarities with *Stolonica aluta* Kott, 1985 (recorded from the south-western part of Western Australia), which has a similar zooid with a long vertical slit on the dorsal tubercle and similar distribution of gonads around the postero-ventral curve of the body, but three folds on each side of the body, a longer gastric caecum and a gastric spur that extends the stomach into the gut loop.

***Symplegma brakenhielmi* (Michaelsen, 1904)**

Diandrocarpa brakenhielmi Michaelsen, 1904: 50.

Symplegma brakenhielmi. — Kott 2004: 71.

Distribution. *Previously recorded* (see Kott 2004): Western Australia (Cape Preston to Cockburn Sound); Queensland (Moreton Bay to Martha Ridgeway Reef). Indonesia, Nouméa, Palau Islands, Fiji, Thailand, Hong Kong, China, Indian Ocean including Sri Lanka. *New record*: Northern Territory (Wessel Islands, NTM E531).

Description. The colony forms a large robust sheet over the substrate. Zooids are dorso-ventrally flattened and completely embedded in the thin test forming a mosaic like pattern seen from the upper surface. Apertures are sessile on the upper (dorsal) surface of each zooid. Characteristic of the genus are the four longitudinal branchial vessels on each side of the branchial sac. The gut forms a tight double loop on the left side of the body and the stomach is large, but relatively short and wide with a conspicuous curved caecum in the pole of the primary gut loop. The two testis follicles, one anterior and one posterior to the small ovarian sac in the middle of the body wall, are lobed. Larvae are in the peribranchial cavity of the newly recorded specimen.

The species and its relationships are discussed in Kott (2004).

***Microcosmus helleri* Herdman, 1882**

(Fig. 3F)

Microcosmus helleri Herdman, 1882: 131; Kott 1985: 349.

Distribution. *Previously recorded* (see Kott 1985): Western Australia (Port Hedland, Cockburn Sound); South Australia (St Vincent Gulf); Indonesia, Java Sea, Singapore, Sri Lanka, West Indian Ocean, West Indies. *New records*: Northern Territory (Wessel Islands, NTM E506, E511).

The species is pan-tropical but also extends into temperate waters around the southern coast of Australia.

Description. The newly recorded specimens, up to about 9 cm long, are tough, hard and leathery, with wrinkled test and some scattered epibionts. The branchial aperture is terminal and turned slightly ventrally. Internally the atrial siphon extends from near the base of the branchial siphon and turns posteriorly, lying at almost 180 degrees to it, opening in the sessile external atrial aperture about halfway down the dorsal surface of the body. Hard, pointed tubercles of the test are around both external openings. Four hard, rounded and slightly spoon-shaped valves are around the base of the branchial siphon and each is folded back against the lining of the siphon from its base just anterior to the branchial tentacles. Siphonal spines were not detected in these specimens. The dorsal tubercle has the double spiral slit characteristic of several species in this genus. Six wide branchial folds are on each side of the body. The gut forms a narrow loop around the ventral margin of the left side and the gonads, divided into three large blocks embedded in the body wall pass from inside the pole of the gut loop, cross its descending limb and continue alongside anterior to the gut loop to the atrial aperture.

Remarks. The course of the left gonad, crossing from inside the pole of the loop and extending close to the rectum, occurs also in *M. exasperatus* Heller, 1878 and *M. squamiger* Michaelson, 1927. However, this large, tough pan-tropical species, which extends into temperate waters around the southern Australian coast, is distinguished by the lack of siphonal spines, the presence of four rather cartilaginous spoon-like valves in the base of the branchial siphon and the six branchial folds on each side of the body.

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